

## Case Report

# Accidental fatal inhalation of sulfuric acid fumes

F.A. Benomran MBChB, MSc, DCH, MD (Director, Senior Consultant and Professor of Forensic Medicine) \*, A.I. Hassan MBChB, MSc, MD (Consultant Forensic Medical Examiner and Lecturer), S.S. Masood MBChB (Forensic Medical Examiner)

*Department of Forensic Medicine, General Department of Forensic Science, Dubai Police General Headquarters,  
P.O. Box 1493, Dubai, United Arab Emirates*

Received 19 June 2006; accepted 12 September 2006  
Available online 18 January 2007

## Abstract

A man found dead with circumstantial evidence indicating exposure to sulfuric acid vapor. He had been applying a solution of concentrated sulfuric acid to a drain pipe in an attempt to clear a blockage. External examination showed moderate corrosive damage around his mouth and nose, on his forearms and tips of fingers of his left hand. Autopsy revealed congestion of the respiratory passages, as well as severe pulmonary edema. Traces of acid and sulfate compounds were chemically detected in his upper respiratory passages. Death was attributed to accidental inhalation of fumes of strong sulfuric acid during application to blocked drainpipes.  
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**Keywords:** Sulfuric acid; Death; Accidental inhalation of toxic fumes

## 1. Introduction

Sulfuric acid is a highly corrosive substance that can damage and destroy human tissues. Its vapor, however, is strongly irritant to the respiratory tract and can cause severe pulmonary edema which could prove fatal.

Mild to moderate inhalation of mists and vapors may cause sore throat, coughing, shortness of breath, labored breathing. Over-exposure causes chemical burns of respiratory tract and is destructive to mucous membranes.

Occupational fatal exposure to caustic, noxious or allergic substances commonly takes place through inhalation. In the United States, from 1992 to 1998, 523 civilian workers died because of the inhalation of harmful substances. The mortality rate was 0.56 deaths per 1,000,000 workers per year.<sup>1</sup>

In the literature, reports on fatal inhalation of fumes from strong acids are very rare. A case report discussed the death of a 43-year-old man while attempting to rescue

his son from a tank used to store spent acids from a metal pickling process.<sup>2</sup> Death could have been due to inhalation of acidic fumes.

## 2. Case report

The dead body of a 27-year-old man was found almost 24 h after he was last seen alive. He was lying on the floor of a very small space of 80 cm width and 120 cm long, in which the drain pipes of the apartment building descend to join the main sewers. This confined space was made by a low wall of one meter, separating it from the rest of the narrow, open-to-sky utility shaft of the multi-storey building. The shaft is accessible by every resident through a door in the ground floor. Due to the confines of the space, the body was flexed at the hips and knees, and the head and upper torso propped up on one wall. The body was in a state of early decomposition as it was summer time and temperature was between 40 °C and 45 °C. A big plume of fine bloody froth was exuding from his mouth. A kitchen glove was on his right hand (Fig. 1).

\* Corresponding author. Tel.: +971 506 580801; fax: +971 420 14551.  
E-mail address: [benemran@hotmail.com](mailto:benemran@hotmail.com) (F.A. Benomran).



Fig. 1. General view of the deceased as he was found lying on the floor of the narrow utility shaft with the loosely closed plastic container of sulfuric acid between his legs.

Immediately under the deceased, was the cover of the main sewer into which the drains are collected. There was a plastic container for fluids between his legs, with its cap loosely closed, and it appeared almost full of liquid material.

His roommates informed the police that the deceased, after having his supper the previous night, went to work on clearing some blocked drains.

External examination of his body showed circum-oral and circum-nasal blackening (Fig. 2), as well as small chemical burns on the forearms and tips of the fingers of the left hand (Fig. 3). Internal examination revealed marked blackening of the laryngeal and tracheal mucosa (Fig. 4), as well as marked congestion of both lungs. There was no evidence of ingestion of caustics. The esophageal mucosa appeared normal (Fig. 5). The gastric mucosa was also normal, and the stomach was full of undigested food.

Oral and nasal swabs were chemically tested and found to be strongly acidic, and contained sulfate compounds. The liquid in the plastic container was a highly concentrated solution of sulfuric acid.



Fig. 2. A close up of the face, showing corrosive injuries about the mouth and nostrils.



Fig. 3. The ungloved left hand showing mild corrosive injury.

### 3. Discussion

Sulfuric acid can be absorbed into the body by inhalation of its aerosol and by ingestion. Evaporation at 20 °C is negligible; a harmful concentration of airborne particles can, however, be reached quickly on spraying.

In this case, the deceased poured a solution of concentrated sulfuric acid in the drains in an attempt to clear a



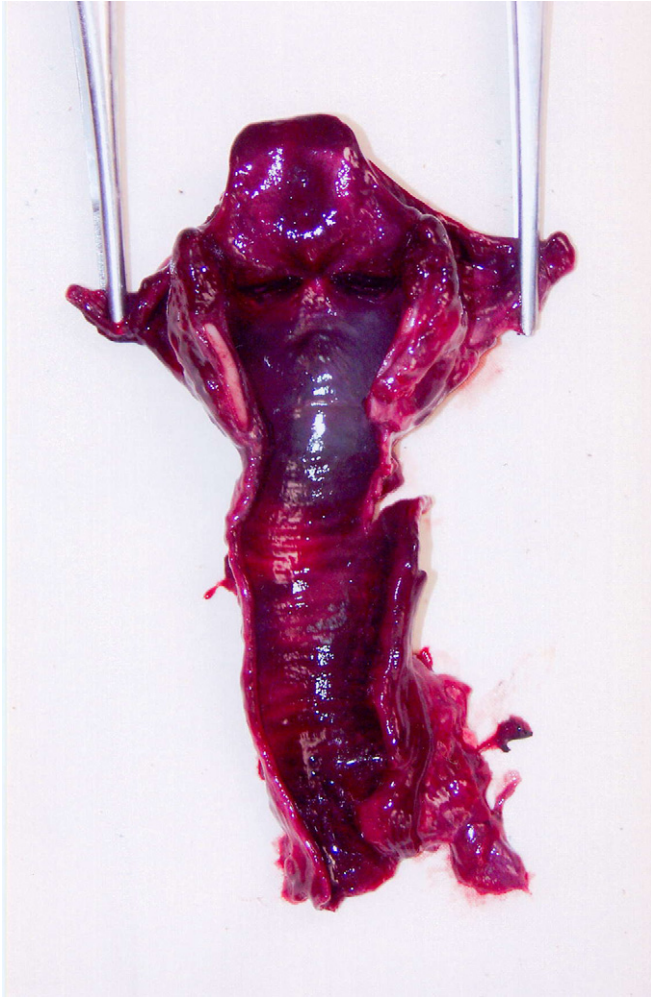


Fig. 4. The autopsy appearance of the inside of the larynx and trachea showing mucosal acid corrosion.

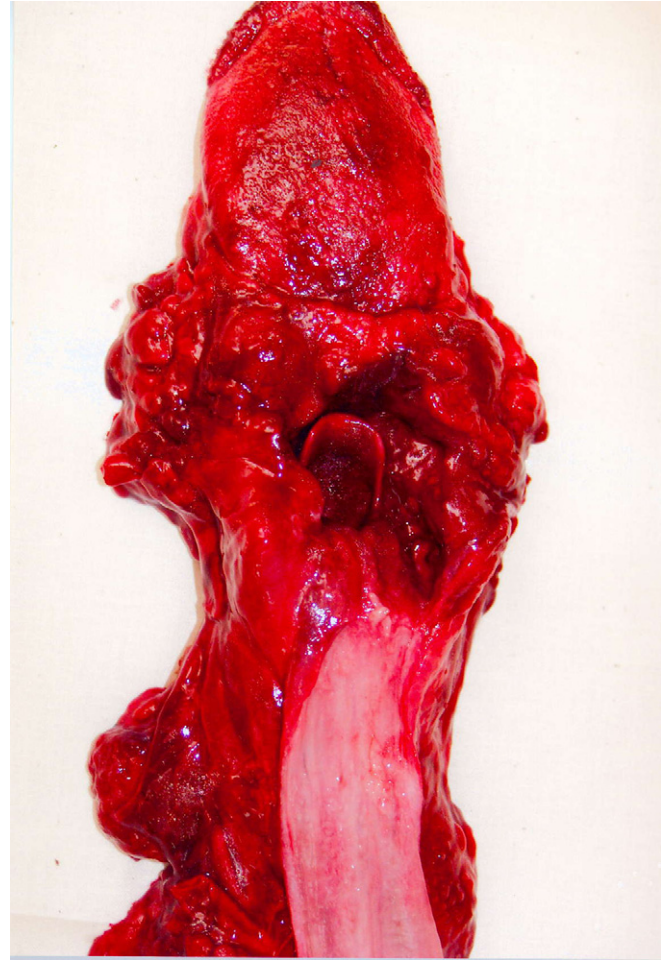


Fig. 5. The mucous membrane of the esophageal lumen showing no evidence of corrosion.

blockage. This dangerous procedure must have produced heavy cloud of irritant acidic fumes and mist. The deceased had accidentally inhaled the toxic fumes, which caused burning of mucous membranes of the respiratory passages. The acid burns around mouth and nostrils might be due to touching by the gloved hand soiled with the strong acid.

The use of strong acids, instead of one of the commercially available clog removing solutions, is a common practice in many areas of third world countries. This case report proves beyond doubt that this procedure is not only dangerous, but it can also be fatal.

The onset of pulmonary edema following inhalation of irritant substances is variable. It largely depends on the quantity and concentration of the toxic vapor. Physical effort may aggravate the respiratory symptoms. Circumstantial evidence in this case indicated that pulmonary edema and death had taken place very quickly following exposure. The presence of undigested food in the stomach, from the last meal prior to his death, puts the onset of death to have been soon after the last meal. This fact indicates that time between exposure to the dangerous substance and death had been rather short.

#### 4. Conclusions

Fatal accidents involving inhalation of toxic vapors from strong acids are rare. Inhalation of toxic substances can exert both local and systemic effects. The local action of caustic substances, however, is detrimental in causing morbidity and mortality. Congestion and edema of the mucous membranes of upper respiratory passages hinders air entry to the lungs. Pulmonary edema interferes with respiratory efficiency of the lungs at alveolar level. Strong acids, namely concentrated sulfuric acid, can produce heavy vapor on contact with different substance including water. In this case, pouring of strong acid into the drains produced fumes that caused the death of the deceased.

#### References

1. Valent et al. Fatal work-related inhalation of harmful substances in the United States-occupational and environmental lung disease. *Chest* 2002;**121**(3):969–75.
2. Western Kentucky University. Request for assistance in preventing occupational fatalities in confined spaces, a case report: <http://www.wku.edu> 1986.